

REMARKS

Applicants appreciate the Examiner's thorough consideration provided the present application. Claims 37-44 are now present in the application. Claims 37-44 have been amended. Claims 45-48 have been withdrawn and hereby cancelled. Claim 37 is independent. Reconsideration of this application, as amended, is respectfully requested.

Claim Rejections Under 35 U.S.C. §112

Claims 37-44 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. This rejection is respectfully traversed.

In view of the foregoing amendments, it is respectfully submitted that this rejection has been addressed. Accordingly, all pending claims comply with the written description requirement. Reconsideration and withdrawal of the rejection under 35 U.S.C. § 112, first paragraph, are therefore respectfully requested.

Claim Rejections Under 35 U.S.C. § 103

Claims 37-43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishizawa, U.S. Patent No. 5,693,139, in view of Edmond, U.S. Patent No. 5,739,554. Claim 44 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishizawa in view of Edmond, and further in view of Manabe, U.S. Patent No. 6,472,690. These rejections are respectfully traversed.

In light of the foregoing amendments to the claims, Applicants respectfully submit that these rejections have been obviated and/or rendered moot. As the Examiner will note,

independent claim 37 has been amended to recite a combination of steps including “supplying a first crystal raw material to form a first layer; after the step of supplying a first crystal raw material stops, supplying a second crystal raw material different from the first crystal raw material to form a second layer on the first layer; supplying at least one p-type impurity raw material and at least one n-type impurity raw material before the step of supplying the second crystal raw material, thereby doping an impurity pair of the at least one p-type impurity raw material and the at least one n-type impurity raw material into only the first layer.” Support for the amendments to claim 37 can be found in FIGs. 2, 3, 7 and 8 and the corresponding description of the specification as originally filed. Applicants respectfully submit that the above combination of elements as set forth in amended independent claim 37 is not disclosed nor suggested by the references relied on by the Examiner.

In particular, Nishizawa in col. 8, lines 32-57 discloses forming a p-type growth layer using TMG (raw material for forming Ga layer), AsH₃ (raw material for forming As layer) and DMZn (p-type impurity material) and forming an n-type growth layer using TMG, (raw material for forming Ga layer), AsH₃ (raw material for forming As layer) and DMSe (n-type impurity material). More specifically, Nishizawa discloses three ways to form a p-type GaN layer using the following orders to introduce the raw materials and the p-type impurity material:

1. TMG + DMZn → AsH₃;
2. TMG → AsH₃ + DMZn; or
3. TMG + DMZn → AsH₃ → TMG → AsH₃.

Nishizawa also discloses two ways to form an n-type GaN layer by using the following orders to introduce the raw materials and the n-type impurity material:

1. $\text{TMG} + \text{DMSe} \rightarrow \text{AsH}_3 + \text{DMSe}$; or
2. $\text{TMG} + \text{DMSe} \rightarrow \text{AsH}_3$.

In other words, only one type (either p- or n-type) of the impurity material will be doped into the Ga layer or the As layer. However, neither of the Ga layer nor the As layer alone has both p-type and n-type impurity materials therein. Therefore, Nishizawa fails to teach “supplying at least one p-type impurity raw material and at least one n-type impurity raw material before the step of supplying the second crystal raw material, thereby *doping an impurity pair of the at least one p-type impurity raw material and the at least one n-type impurity raw material into only the first layer*” as recited in claim 37.

Edmond also fails to cure the deficiencies of Nishizawa. In particular, although Edmond in col. 4, lines 59-61 discloses that the GaN layer is co-doped with both a Group II acceptor (p-type impurity) and a Group IV donor (n-type impurity), Edmond nowhere discloses that the Group II acceptor and the Group IV donor are co-doped in only one of the Ga layer and the N layer. Therefore, Edmond also fails to teach “supplying at least one p-type impurity raw material and at least one n-type impurity raw material before the step of supplying the second crystal raw material, thereby *doping an impurity pair of the at least one p-type impurity raw material and the at least one n-type impurity raw material into only the first layer*” as recited in claim 37.

With regard to the Examiner’s reliance on Manabe, this reference has only been relied on for its teachings of supplying TESI. This reference also fails to disclose the above combination of steps as set forth in amended independent claim 37. Accordingly, this reference also fails to cure the deficiencies of Nishizawa.

Unlike the utilized references, in the present invention, since an impurity pair of the at least one p-type impurity raw material and the at least one n-type impurity raw material into the same first layer, it decreases the energy level, i.e., the activation energy of the semiconductor. As a result, as embodied in FIGs. 7-10 of the present application, the carrier concentration of a p-type GaN is increased from $2.6 \times 10^{18}/\text{cm}^3$ to $1.1 \times 10^{19}/\text{cm}^3$, which provides higher conductance. This feature is clearly absent from the utilized references.

Accordingly, none of the references utilized by the Examiner individually or in combination teach or suggest the limitations of amended independent claim 37 or its dependent claims. Therefore, Applicants respectfully submit that claim 37 and its dependent claims clearly define over the teachings of the references relied on by the Examiner.

Accordingly, reconsideration and withdrawal of the rejections under 35 U.S.C. § 103 are respectfully requested.

CONCLUSION

It is believed that a full and complete response has been made to the Office Action, and that as such, the Examiner is respectfully requested to send the application to Issue.

In the event there are any matters remaining in this application, the Examiner is invited to contact Cheng-Kang (Greg) Hsu, Registration No. 61,007 at (703) 205-8000 in the Washington, D.C. area.

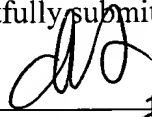
Application No. 09/941,612
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If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

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